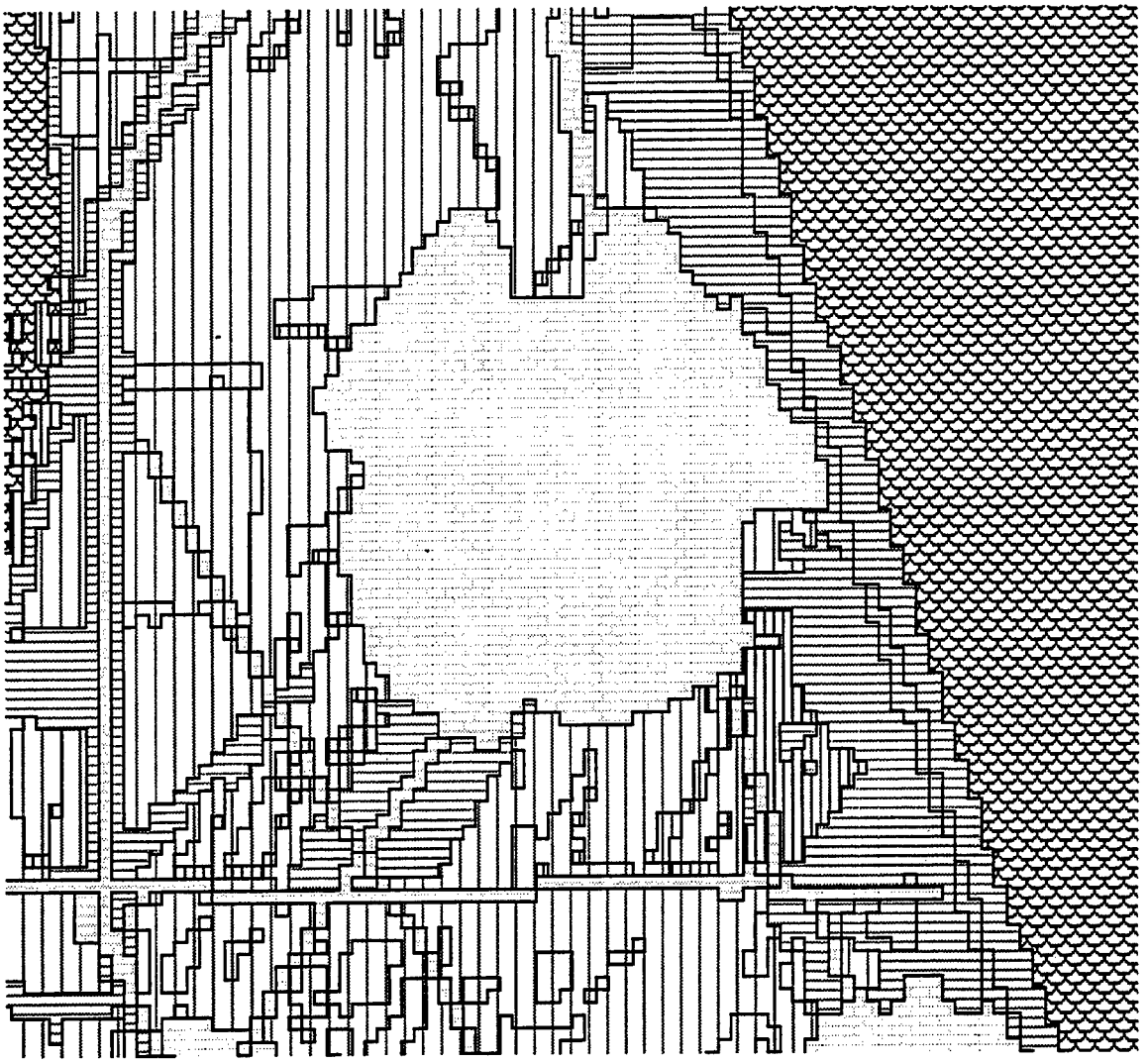
Table 3.1-3. Enumeration of Community Types Comprising Total Area at KSC

Community Type	Area (Acres)
Coastal Dunes	368
Coastal Strand	630
Sand Pine	2
Mixed Oak/Saw Palmetto	16,084
Coastal Live Oak Woods	323
Slash Pine Flatwoods	8,745
Live Oak/Cabbage Palm Hammock	2,039
Red Bay/Laurel Oak/Live Oak	3,128
Cabbage Palm Hammock	1,775
Southern Red Cedar/Live Oak Hammocks	181
Saltmarsh Cordgrass	56
Black Mangrove	2,641
Saltwort/Glasswort	621
Black Mangrove/Saltwort/Glasswort	100
Mixed Salt-Tolerant Grasses Marsh	2350
White Mangrove/Mixed Mangrove	1,198
Sea Oxeye	298
Mud Flats	283
Willow Swamp	1,797
Hardwood Swamp	1,095
Mixed Grass/Sedge	110
Cattail Marsh	33,652
Graminoid Marsh	10,436
Cabbage Palm Savanna	5,385
Wax Myrtle/Brazilian Pepper	1,318
Australian Pine	465
Southern Red Cedar Thicket	88
Shrub/Herbaceous Spoil Vegetation	265
Citrus	2,688
Mixed Oak/Saw Palmetto Disturbed	1,119
Dikes	2316
Dead Mangrove	201
Ruderal	2,938
Beach/Bare Ground	429
Oceanic	0
Open Lagoonal and Associated	22,485
Impounded Waters	8,837
Inland Waters	209
Landfill Ditches, Borrow Pit	523
Transportation	2,333
Cultural Features	485
TOTAL	**140,000**

Source: KSC 1994



LEGEND:
- Uplands Vegetation
- Wetlands
- Developed Area
- Open or Impounded Waters
- Scrub Vegetation

N
W E
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Figure 3.1-8. CCAS SLC-37 Area Vegetation Map

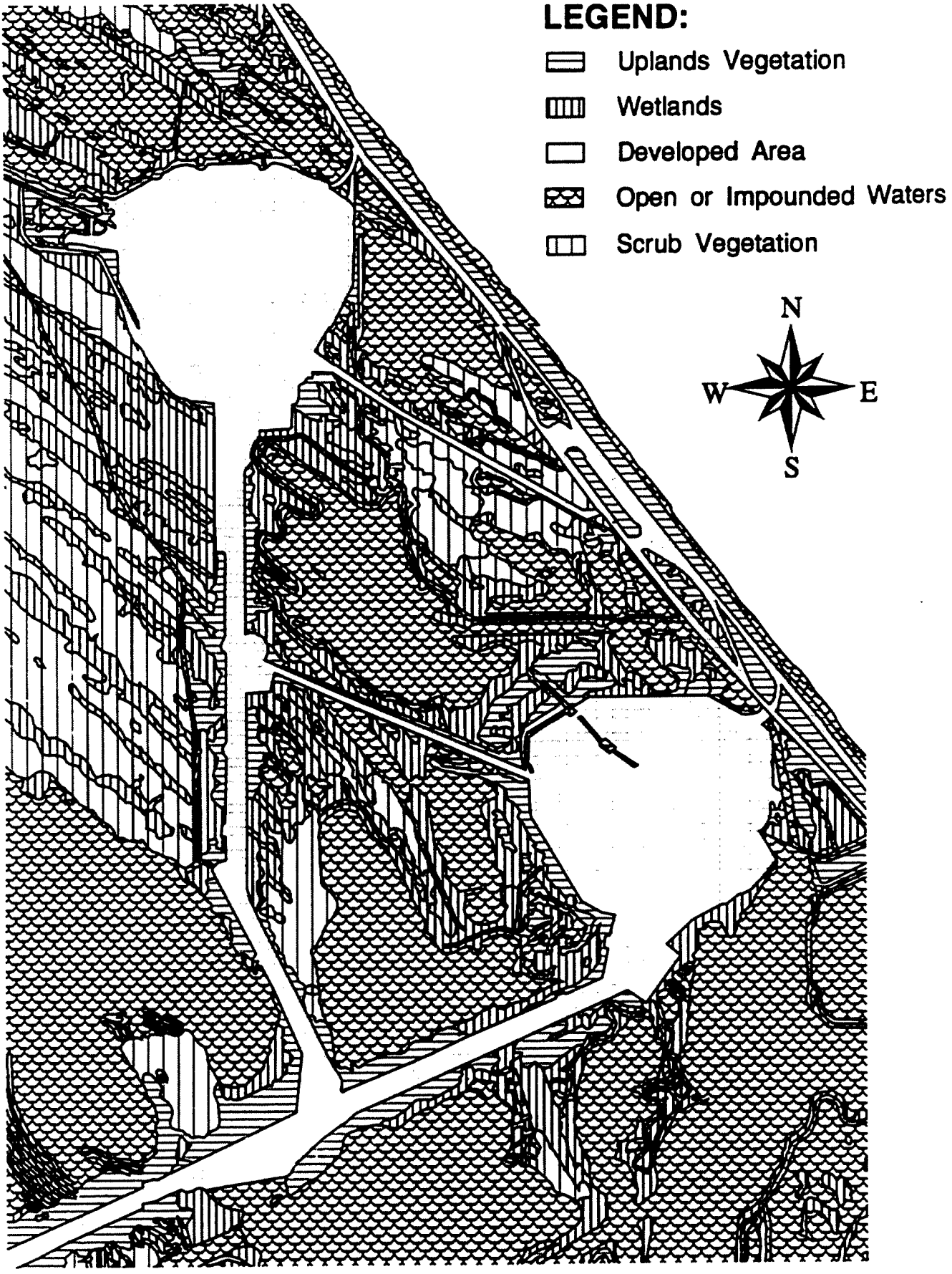

Figure 3.1-9. KSC LC-39 Area Vegetation Map

Over 53,800 ha (133,000 ac) of KSC property are managed as a refuge by USFWS and the National Park Service (NPS). USFWS operates and maintains MINWR, which shares a common boundary with KSC. The refuge was organized in 1972 as a buffer zone for wildlife preservation. NPS operates and maintains the Canaveral National Seashore (CNS), which was established in

1975 to ensure preservation of the least disturbed and undeveloped coastal segment remaining along Florida's eastern shoreline. USFWS and NPS maintain the large and diverse communities of flora and fauna at KSC.

Uplands provide important habitat for many bird species, including the threatened Florida scrub jay *(Aphelcoma coerulescens coerulescens)*. Pileated woodpeckers, gray squirrels, armadillos, and migratory warblers are also common residents of these areas.

The Indian River Lagoon system has nearly 150 species of fish. Lagoons and rivers support commercial fishery operations for both shellfish and fin fish, including blue crabs, shrimp, clams, and mullet. Offshore, the KSC area is one of the most productive fisheries along the east coast of Florida where commercial scallop fishery predominates. A number of renewable oyster leases are also held in the waters near KSC.

KSC and the surrounding coastal areas provide habitat for over 300 bird species; nearly 90 species are resident breeders, over 100 species winter at KSC, and the remainder are migratory. Twenty-four species are on the protected species list. More than 31 species of mammals inhabit the Merritt Island land mass, including the white-tailed deer, feral hog, and bobcat. Two mammals are aquatic: the Atlantic bottlenose (river resident) dolphin and West Indian manatee *(Trichechus manatus)*. Ten species of mammals are Federally protected. Fifty-two species of reptiles (12 Federally protected) and 16 amphibian species (one is a Species of Special Concern) are known to inhabit the KSC area. (KSC 1994, GPO 1992, KSC 1992)

3.1.3.5 Threatened, Endangered, and Sensitive Species

Forty-nine (49) wildlife species and 73 plants (69 native) listed as Federally or State threatened or endangered are known to occur on ER. Animals that could potentially be affected by the X-33 Program include: Atlantic loggerhead turtle *(Caretta caretta caretta)*, Atlantic green turtle *(Chelonia mydas mydas)*, Eastern indigo snake *(Drymarchon corais couperi)*, gopher tortoise, gopher frog *(Rana capito)*, Florida scrub jay *(Aphelcoma coerulescens coerulescens)*, Southeastern beach mouse *(Peromyscus polionotus niveiventris)*, and West Indian manatee. If placement of a landing pad is required in the KSC LC-39 area, any of the wetlands flora could potentially be affected, depending upon specific location.

ER beaches encompass over 68 km (42 mi) and are critical nesting grounds for threatened Atlantic loggerhead and endangered green sea turtles. When turtle nests are located on CCAS, barriers are installed to block artificial light from launch facilities. These lights may lead hatchling turtles away from the sea, resulting in increased mortality. Other physical barriers are installed to impede

inland movement by young turtles. A lighting policy has been implemented by the ER for management of exterior lights. Requirements state that low-pressure sodium lights must be used unless prohibited for safety or security purposes, and all exterior lights must be turned off when not required for mission operations. Additionally, wire mesh covers are placed over turtle nests to protect them from feral hogs and raccoons. In addition, raccoons are removed by trapping along the dune line. (KSC 1994, CCAS 1994-A)

Although the eastern indigo snake often inhabits dry, sandy areas, it is actually characteristic of moister habitats. In the drier environments, the indigo snake invariably seeks shelter in the burrows of the gopher tortoise. A population estimate of 750 has been reported by USFWS. Tracking studies highlight the importance of well-drained areas, which comprise about 2 percent of all ER lands.

Gopher tortoises use the range of coastal scrub, coastal strand, pine flatwoods, and disturbed habitats at ER. Gopher burrows can be extensive, sometimes reaching a depth of 4 m (12 ft) and a length of 9 m (30 ft). A number of important species, including the indigo snake, gopher frog, and southeastern beach mouse are known to utilize both active and abandoned burrows as refuge.

Gopher frogs are nocturnal, normally spending daylight hours within moist habitat provided by gopher tortoise burrows. Population and densities are undetermined.

The Florida scrub jay is a 30 cm (12 in) crestless jay totally lacking the white-tipped wing and tail feathers of more common and widespread blue jay. ER supports one of the largest populations in the state (approximately 50 percent) with an estimated 1,400-3,600 birds. Scrub jays avoid wet habitats and forests, preferring scrub and slash pine. Nests are usually placed 1 to 4 m (4 to 12 ft) above the ground in scrub oaks or sand pines *(Quercus geminata)*. Frequently they will nest fairly close together. Nesting usually takes place between March and May.

Preferred habitat of the southeastern beach mouse includes vegetation zones paralleling the beach and dune lines characterized by clumps of palmetto and sea grape *(Coccoloba uvifera)* and expanses of open sand. Although substantial populations remain on ER, mice are more prolific during winter months.

The Banana River is designated as critical habitat for the West Indian manatee, a massive, fusiform, thick-skinned, nearly hairless aquatic mammal. Manatees have paddlelike forelimbs, horizontally flattened tails, and cleft, lobed, fleshy upper lips set with bristles. Average weight is between 360 and 450 kg (790 and 1190 lb), and average length is 3 m (10 ft). Census reports indicate that over 20 percent of Florida's manatee population utilize Banana River lagoonal waters at ER each spring. Peak numbers are recorded in spring and fall each year. Particular care is given to ER operations which take place adjacent to or within waters which provide habitat for the manatee. The turning basin west of Hangar AF has been identified as an area of manatee concentration.

For a complete listing of the threatened, endangered, and sensitive species occurring on the ER, see Appendix B.

3.1.3.6 Cultural Resources

The KSC LC-39 area is an NRHP-designated Historic Site by virtue of the role it played in landing humans on the moon. As such, any modifications to the complex must be reviewed by the SHPO. The SHPO has long recognized that KSC LC-39 facilities are part of an actively utilized infrastructure and changes are part of the work done here. Therefore, KSC has been able to obtain approval for all required modifications to the complex, as is evidenced by those required for the Space Shuttle Program in the 1970's and 1980's. SLC-37 has been determined ineligible for listing in the NRHP. (CCAS 1996-A, KSC 1995, JPL 1995)

There are no archeological resources associated with either the SLC-37 or the KSC LC-39 site. (CCAS 1991, KSC 1995, JPL 1995)

3.1.3.7 Water Resources

The City of Cocoa is contracted to supply water to ER. The water delivered is partially chlorinated and softened; it is rechlorinated before being introduced to the CCAS/KSC system. The water distribution system at CCAS consists of 193 km (120 mi) of underground lines, eight pump stations, three fire-pump stations, and five water supply buildings. Most wells at CCAS are relatively shallow (6 to 15 m (20 to 50 ft)), but some are up to 122 m (400 ft) deep. Some wells are plugged; however, a number are deteriorated and continue to flow. According to the Brevard County Water Resources Department (BCWRD), a number of wells are still in use for irrigation, domestic use, fire protection and mosquito control. Maximum potable water storage capacity at CCAS is 2.5 million L (0.65 million gal). Nine ground level tanks store approximately 20 million L (5.3 million gal) to supply the deluge water system. Average daily demand at CCAS is 2.2 mLd (0.57 mgd); peak capacity is 3.56 mLd (0.94 mgd). The City of Cocoa can supply up to 11.4 mLd (3 mgd). Water can also be supplied to CCAS through PAFB by the City of Melbourne. (CCAS 1994-A, CCAS 1996-B)

Average daily demand for water at KSC is 3.8 mLd (1 mgd). The City of Cocoa can supply a maximum of approximately 15 mLd (4 mgd). Water can also be supplied to KSC by the City of Titusville, and six on-base wells are available. Total storage capacity at KSC is approximately 15 million L (4 million gal) in 10 AST's. KSC LC-39 has a 4 million L (1 million gal) ground storage tank and a 950,000 L (250,000 gal) elevated storage tank. An identical water tower is found in the Industrial Area. Fire suppression system booster pump stations and a potable water system emergency pump are located within the Utility Annex, which gets its supply from the VAB area ground storage tank. (CCAS 1992)

3.1.3.8 Geology and Soils

ER is constructed atop two large barrier islands and supported by a portion of the Florida plateau, a huge carbonate platform of limestone layers and other sediment. Above these limestones are sediment formations containing sand, silts, clay and coquina rock averaging 48 m (160 ft) thick.

The plateau's aggregate thickness is 600 m (2,000 ft), most of which is below sea level and extends a great distance from the coastline, comprising the ocean floor. (KSC 1992). Bedrock is a hard-to-dense limestone known as the Ocala Formation located 23 to 92 m (75 to 300 ft) below the surface. The Ocala Formation is one of the principal parts of the Florida Artesian Aquifer. The Ocala Formation is overlain by the Hawthorne Formation (a sandy limestone), Caloosahatchie Formation (a calcareous clay with fragments of shells), Anastasia Formation (coquinoid limestone), and Pamlico Formation (unconsolidated and well-graded quartz sand). Surficial geology is a mixture of permeable sand and shell materials. (CCAS 1991)

CCAS is approximately 7.2 km (4.5 mi) wide at its widest location and varies in elevation from sea level to approximately 6.1 m (20 ft) above sea level. The topography consists of a series of nearly level and gently sloping ridges interspersed with narrow, wet sloughs which roughly parallel coastal and lagoon shorelines. Soil bearing studies confirm that Cape soils support bearing loads of 1,100 to 1,800 kg (2,500 to 4,000 lb) per 0.1 sq m (1 sq ft). Test values for these soils indicate a need for stabilizing subbase materials before placement of special test equipment.

Soils and subsoils at KSC are corrosive due to various factors, including sea salts, high water tables, and reactive soil materials. Due to the chemical hydrology of the surficial aquifer, subsurface metallic piping and storage vessels corrode within a relatively short period of time. Isolation and cathodic protection are methods used to minimize corrosive effects. Polyvinyl chloride (PVC) pipe is frequently used to overcome soil conditions which destroy concrete and metallic materials. (KSC 1992)

3.1.3.9 Health and Safety

A joint contract between NASA and CCAS was implemented to handle accident cases, physical examinations, and emergencies involving the workforce. A mutual agreement for fire protection services exists between the city of Cape Canaveral, KSC, and LBSC at CCAS. Medical services are provided by an Occupational Health Facility and Emergency Aid Clinic. Facilities are staffed by medical personnel specially trained in hazards and treatment associated with operations. Medical facilities are equipped to provide first-care treatment of injuries. Ambulance service and a medically equipped helicopter are available to transfer injured personnel to full-care medical facilities. Coordination support agreements between local municipalities provide for reciprocal support in the event of an emergency or disaster. (KSC 1994, CCAS 1994-A)

Three fire stations, two located in the VAB area and one located in the Industrial Area, provide effective coverage for KSC. Fire protection services are limited at CCAS, consisting of one main fire station and two smaller auxiliary stations. Almost 10 km (6 mi) of water mains are dedicated to fire distribution; 12 water tanks provide a combined storage capacity of 23 million L (6.0 million gal). Police facilities include pass issuance, central police control, police operations, and several small entry control buildings. (KSC 1994, CCAS 1994-A)

Specific safety and health requirements for the X-33 Program will be developed by the ER in conjunction with NASA and the X-33 Phase II Industry Partner. As a minimum, the X-33

Program can expect to submit preliminary and final site plans, safety standard operating procedures, a safety assessment report, and a missile flight safety operational plan. These documents will be prepared in accordance with NASA/KSC, USAF/CCAS, and DOD regulations.

3.1.3.10 Operational Noise

Noise levels which may affect environmental attributes are primarily related to launch activities, which are single-event, short-duration sources specifically related to combustion of rocket propellant. The highest acoustic noise levels generated by Space Shuttles are recorded within the first 2 minutes of launch. In the launch vicinity, noise levels can exceed 160 dBA. Noise levels recorded at the Launch Impact Line (VAB area) do not exceed the 115 dBA maximum level established for short exposure by the Department of Labor Standards. For maximum protection, observer areas and security zones have been set at distances where the 115 dBA sound level is not exceeded (KSC 1994). Noise is usually perceived by surrounding communities as a distant rumble. A concrete exhaust flume on each pad deflects exhaust gases away from the pad to reduce noise and shock wave that result from ignition of solid rockets and the first stage of the launch vehicle. Aircraft operations create a similar source of noise; however, these are infrequent single events which usually do not exceed installation boundaries, with the exception of approach zones. (JPL 1995)

Noise levels within various industrial shop areas are monitored by NASA Environmental Health. Monitoring is conducted to ensure personnel exposure levels are in compliance with standards established by OSHA. Day-to-day operations at ER would most likely approximate urban industrial areas, reaching levels of 60 to 80 dBA, with a 24-hour average ambient noise level that is somewhat lower than the EPA-recommended upper level of 70 dBA. Other sources of noise, such as construction activity and vehicular traffic, are considered acceptable with regard to personnel exposure and have not been documented to adversely impact wildlife or other environmental attributes. The closest off-range civilian noise receptors would be commercial activities located on the north side of Port Canaveral. The majority of operations are industrial in nature, which generate local noise at levels greater than those which may be detected from ER. (CCAS 1992, JPL 1995)

Space launches generate sonic booms during vehicle ascent and stage reentry. Launch-generated sonic booms are directed upward and in front of the vehicle and occur over the Atlantic Ocean. Stage reentry sonic booms also occur over open ocean and do not impact developed coastal areas. (JPL 1995)

3.1.3.11 Transportation

Roadways

Federal, state, and local roads provide highway service for Brevard County. Principal routes are Interstate 95, U.S. Highway 1, and SR's 3, A1A, 402, 406, 407, 520, and 528. Bridges and

causeways link urban areas on beaches to Merritt Island and the mainland. All roads have control access points which are manned 24 hours a day, 7 days a week. (CCAS 1994-A)

All paved roads conform to the American Association of State Highway and Transportation specification H20-S16. This specification establishes a load bearing capacity of 18,000 kg (20 tons) for a tractor-truck and a gross single axle weight of 15,000 kg (16 tons). Design standards for primary roads and highways mandate 7 m (24 ft) widths and, for two lane roads, a 12 m (40 ft) wide median strip.

CCAS has 130 km (81 mi) of paved roads serving various launch, support, and Industrial Area facilities. The road system is linked to the regional highway system by NASA Causeway to the west, SR 402 to the north, and the CCAS south gate and State Highway A1A to the south. There are approximately 332 km (206 mi) of roadway at KSC, with 254 km (158 mi) of paved roads and 77 km (48 mi) of unpaved roads.

Railroads

The Florida East Coast (FEC) Railway affords rail service to the county, with a main line through the cities of Titusville, Cocoa, and Melbourne. The spur spans the Indian River and Intracoastal Waterway via a causeway and bascule bridge on the mainland to Merritt Island. Approximately 64 km (40 mi) of rail track provide heavy freight transport to ER (KSC 1994, CCAS 1994-A). NASA owns its own railroad at KSC. Sixty-four km (40 mi) of track extends from the FEC Railway in Titusville across the Indian River, through KSC to CCAS. Three locomotives and approximately 65 railcars provide service to NASA, USAF, U.S. Army, USN, other agencies, and space launch contractors. Annual traffic is approximately 3,000 cars. The railroad is used to transport hazardous materials and equipment, Space Shuttle components, and over-dimensional freight. (NASA 1996-B)

Airports

Major commercial air service facilities are located at the Orlando International Airport. Most major domestic and several international airlines serve the airport. The Melbourne International Airport is located in southern Brevard County and provides the Space Coast with major international and regional carriers. The Space Center Executive Airport, located in northern Brevard County near Titusville, is a full service facility for corporate and commercial jet traffic. In addition, the Merritt Island Airport, Rockledge Air Park, and Arthur Dunn Airport are all Brevard County fixed-base operators with asphalt runways ranging from 620 to 915 m (2,000 to 3,000 ft). Military airfields are located at CCAS and PAFB. (KSC 1994, CCAS 1994-A, USAF 1996)

Seaports

Port Canaveral, located at the southern boundary of CCAS, is the area seaport. Navigable access from Port Canaveral to ER docking facilities at Hangar AF (CCAS) and the Barge Turning Basin (KSC) is provided by 31 km (19 mi) of maintained channels. Docking facilities at Hangar AF are

used primarily in retrieval of SRB motors following launch of the Space Shuttle. The Turning Basin is used to unload external fuel tanks and other heavy equipment suited to waterway transport. A total of 480 m (1,580 ft) of dockage is available at existing wharf facilities. Industrial and commercial facilities are located at the port, and cruise ship use is increasing. (KSC 1994, CCAS 1994-D)

An area transportation map is depicted in Figure 3.1-10.

3.1.3.12 Population and Employment

The Brevard County 1990 census population was 398,978; however, more recent estimates approach 435,752. The communities of Palm Bay, Melbourne, and Titusville are the largest, with populations that approximate 71,476, 65,583, and 40,978 respectively. Major employers include CCAS, PAFB, KSC, and technical and aerospace firms located south of Titusville, in Melbourne, and in Palm Bay. The presence of DOD, NASA, and the technical and aerospace firms represents a predominant economic force, generating an estimated employment population of 80,000. (KSC 1994, CCAS 1991)

Approximately 18,253 personnel were employed at KSC at the end of September 1993, including contractor, construction, tenant, and permanent civil service employees. Civil service employees account for approximately 14 percent of the total workforce. Approximately 50 percent of the personnel at KSC have positions directly related to the Space Shuttle and payload processing operations. The remainder are employed in ground and base support, unmanned launch programs, crew training, engineering and administrative positions. (KSC 1994)

The highest employment levels were recorded during the Apollo Program. In 1968, a peak population of 25,895 was recorded and an estimated one in four workers in Brevard County were employed by operations at KSC. Employment levels dropped precipitously following the Apollo Program to a historic low in 1976 when a total of 8,441 personnel were employed. Employment levels rose in 1979 when KSC was designated as the launch and operations support center for the Space Shuttle Program, gradually increasing through 1985 as the number of launch events increased. (KSC 1994)

3.2 Global Environment

The main global environmental issues relevant to the X-33 Program are related to the tropospheric and stratospheric layers of the atmosphere. The Earth's atmospheric layers are delineated in Figure 3.2-1. X-33 test flights will occur in and transit all layers of the Earth's atmosphere, to altitudes exceeding 75 km (47 mi). Consideration of the effect of X-33 and successor RLV's which will orbit at altitudes exceeding 160 km (100 mi) on the troposphere and especially the stratosphere are important since these effects cannot be mitigated.